ED210160

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

John P. Schellenberg

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

RESEARCH REPORT ON COLLEGE LEVEL PHYSICAL SCIENCE FOR NON-MAJORS

Prepared by

Dr. John P. Schellenberg
Associate Professor of Physical Science
Kutztown State College
Kutztown, Pennsylvania

Fall 1980

SE 035 884

ABSTRACT

This research report focuses on an experimental study comparing two laboratory approaches to a college level physical science course for non-majors. An approach using contemporary topics was compared to an approach using standard topics. The three dependent variables were achievement of subject content, scientific attitude and understanding the nature of science. The data analysis showed no significant difference between treatments.

The study used design features intended to control possible teacher effect. Of these a treatment monitoring instrument used to measure congruence between intended and actual treatment proved very useful. It showed on a second trial of the experiment that one of the laboratory instructors did not follow the intended treatment. This was valuable to the investigator in the analysis of his data for that trial.

The investigator strongly recommends that such monitoring techniques be included in this type of experimental designs.

Prepared by

Dr. John P. Schellenberg
Associate Professor of Physical Science
Kutztown State College
Kutztown, Penna.
Fall 1980

RESEARCH REPORT ON
COLLEGE LEVEL PHYSICAL SCIENCE FOR NON-MAJORS

The author of this study has taught introductory physical science courses for non-science majors since 1966. Since 1976 he and colleagues have been attempting a variety of instructional materials and methods to improve the general education value of such courses. The purpose of the course improvements was to improve the scientific literacy of the students. In 1978, it was decided that a method which allowed the laboratory phase of the course to focus on contemporary topics was appealing to both students and laboratory instructors.

A formal experimental study was designed to compare the contemporary topics laboratory approach with a previously used standard topics laboratory approach.

The literature review of previous studies on general education physical science courses for non-science majors indicated a pattern of concern for three objectives. The first objective is the mastery of selected facts and principles which comprise the subject content. The other objectives are often described as referents of scientific literacy: scientific attitude and understanding the nature of science (processes).

The achievement or mastery of subject content is measured by an instructor prepared test. The scientific attitude was measured by an instrument titled the Scientific Attitude Inventory (SAI) developed by Richard Moore. The understanding of the nature of science was measured by an instrument titled the Science Process Inventory (SPI), Form D, developed by Wayne Welch. A pretest-posttest design was employed. Analysis of covariance was used as the statistical model.

The design of the study paid special attention to several features of experimental studies in the area. In regard to teacher effect, the author designed the study so that he was not involved in either treatment. Also, an instrument was constructed to monitor the teacher effort on the prescribed treatments. Each instructor was provided with a manual detailing the appropriate treatment for each week of laboratory. At the college level, it is difficult to create equivalent treatment groups. This was achieved by allowing double enrollment followed by pairing students on ability (SAT-total scores), thereby creating two ability equivalent treatment groups.

The experimental treatment was conducted initially for an eight-week trial . A second trial of fifteen weeks was also conducted. The contemporary topics approach remained the more popular method with both students and faculty. The analysis of data from both trials indicated no significant difference on any of the criterion variables (Table 1).

Table 1

MEAN SCORES ON PRETEST AND POSTTEST ON SUBJECT CONTENT AND UNDERSTANDING THE NATURE OF SCIENCE AND SCIENTIFIC ATTITUDE FOR BOTH TRIAL ONE AND TRIAL TWO.

		Subject Content	Understanding the Nature of Science	Scientific Attitude
Trial 1 Standard Topics	Pretest	28.3	107.3	115.6
	Posttest	49.5	106.7	117.3
Trial 1 Contemp. Topics	Pretest	26.9	105.4	118.3
	Posttest	49.1	103.6	116.3
Trial 2 Standard Topics	Pretest	-	104.6	117.3
	Posttest	-	106.4	116.4
Trial 2 Contemp. Topics	Pretest	-	104.3	117.6
	Posttest	-	107.4	115.7

The experimental conclusion was that either treatment could be used with equivalent results.

The more important finding of this study was the effectiveness of the treatment monitoring instrument in detecting a variation in the application of the experimental treatment during the second trial (Table 2). Questions A8 and A10 did not meet the statistical requirement for trial 2 contemporary topics group. A closer investigation showed that one of the laboratory instructors assigned to teach by the contemporary approach chose not to do so. It is a very important conclusion of this study that an instrument can be used to monitor treatments and that such monitoring is an essential factor in the design of subsequent studies.

Table 2

RESPONSE FREQUENCY ON MONITORING INSTRUMENT CRITERION QUESTIONS FOR BOTH TRIAL ONE AND TRIAL TWO

Criterion Monitoring Questions	Response	Trial 1 Standard Topics (n=41)	Trial 1 Contemp. Topics (n=45)	Trial 2 Standard Topics (n=111)	Trial 2 Contemp. Topics (n=92)
A3	Affirmative	12	29	23	56
	Negative	29	16	88	36
A4	Affirmative	35	5	93	10
	Negative	6	40	18	82
A8	Affirmative	24	42	80	54
	Negative	17	3	31	38
A10	Affirmative	7	40	17	60
	Negative	34	5	94	32
B3	Less 50 min.	26	1	92	58
	More 50 min.	15	44	19	34
B5	Less 50 min.	27	3	82	42
	More 50 min.	14	42	19	50

The monitoring perception questionnaire had two parts. Part A contained 14 questions which allowed for positive or negative responses and four of the questions should have shown a difference. Part B contained 5 questions which allowed for a time spent response and two of the questions should have shown a difference.

The experience and results of this study provides several insights for future studies in this area. Although the experimental approach did not provide a statistically significant difference on the criterion variables, there was evidence of satisfication with the method and could be used as a preferred method. Investigations of this type at the college level are very useful in clarifying the purpose of such courses. The science education faculty should elicit the assistance of their science faculty colleagues to investigate this area since the faculty who teach such courses are rarely involved in educational research. Investigators should avoid being active participants in the treatments but must be diligent in their monitoring of the treatment. The instruments used in this study are widely accepted but precise data on their use is limited. Although the author does not feel more instruments are needed, he does feel a larger data base and wider applications of testing at this level is definitely needed.

REFERENCES

A comparative study of the effectiveness of three methods of teaching a general education Physical Science course. Unpublished doctoral dissertation, Colorado State University, 1968.

A comparative study of two laboratory approaches in a general education physical science course. Unpublished doctoral dissertation, The Pennsylvania State University, 1980.

A comparison of achievement and attitudes in college chemistry classes having direct laboratory, vicarious laboratory or written descriptive narrative laboratory experiences. Unpublished doctoral dissertation, West Virginia University, 1973.

A comparison of two laboratory methods investigating interest and the understanding of the process of science in a general Physical Science course, unpublished doctoral dissertation, University of Northern Colorado, 1975.

A comparison of students' achievement and attitude changes resulting from a laboratory and non-laboratory approach to general education physical science courses. Unpublished doctoral dissertation, University of Northern Colorado, 1972.

A comparison of two methods of science instruction in a college general studies program: a laboratory-centered and a group discussion approach. Unpublished doctoral dissertation, Arizona State University, 1972.

A statistical comparison between inductive and traditional laboratories in college physical science. Journal of Research in Science Teaching, 1968, 5, 269-276.

A study of three outcomes of a college level course in physical science for nonscience students (adapted PSNS). Unpublished doctoral dissertation, The Ohio State University, 1971.

An analysis of several instruments measuring 'Nature of Science' objectives. Science Education, 1974,. 58, 321-329.

An evaluation of the use of an anthology of articles on the understanding of science selected to improve student attitudes toward science. Unpublished doctoral dissertation, The University of Iowa, 1975.

An experimental study of three different patterns of student participation in a general education science course for college freshmen. Dissertation Abstracts 19: 2512, Ann Arbor, Mich., 1957.

Development of understanding about the nature of science. Journal of Research in Science Teaching, 1971, 8 (1), 57-66.

Development of a more flexible physical science laboratory program for non-science majors with superior high school science backgrounds. Research Report of Wisconsin State Universities, Educational Resource Information Center, ERIC Document ED 053-987, 1969.

Education for scientific literacy: a conceptual frame of reference and some applications. Science Education, 1974, 58 (3), 403-415.

Forty years of research in science education. National Association for Research in Science Teaching. Educational Resources Information Center, ERIC Document ED 091 235, 1974.

Interest change occasioned by two types of instruction in a coolege general education physical science course. Unpublished doctoral dissertation, Syracuse University, 1965.

Is the science laboratory necessary for general education science courses? Science Education, 1950, 34, 73-77.

Recent research on attitudes concerning science. Science Education, 1969, 53 (4), 295-305.

Referents to scientific literacy. Journal of Research in Science Teaching, 1966, 4, 199-208.

Research on teaching in higher education. In Travers, Robt. (Ed) Second handbook of research on teaching. Chicago: Rand McNally, 1973.

Research on teaching in the natural sciences. In Travers, Robt. (Ed) Second Handbook of Research on Teaching. Chicago: Rand McNally, 1973.

Science education for nonscience students. Science, 1969, 164, 1032.

Science for general education in the colleges. In Rethinking Science Education. Fifty-ninth yearbook of the national society for the study of education. 1960, Chicago, 59 (1), 97-111.

Scientific literacy: basic concepts, skills, and attitudes. Unpublished doctoral dissertation, Texas A & M, 1976.

The attainment of understandings about the scientific enterprise, scientists, and the aims and methods of science by students in a college physical course. Journal of Research Science Teaching, 1969, 6 (1), 47-49.

The development of an instrument for inventorying knowledge of the processes of science. Journal of Research in Science Teaching, 1968, 5, 64-68.

The development of field test and validation of an inventory of scientific attitudes. Journal of Research in Science Teaching, 1970, 7, 85-94.

The effect of the laboratory in achieving general education objectives in a college physical science course. Unpublished doctoral dissertation, University of Arkansas, 1969.

The present status of science attitude measurement: history, theory, and availability of measurement instruments. School Science and Mathematics, 1974, 74, 375-380.